James Acker:
Our last presenter for the morning session is Richard Hansell.

RICHARD HANSELL:
Thanks James, I am glad to be here.

I'm loading up powerpoint now.

James Acker:
Richard, I just made you the presenter -- you can upload and run with the ball!

juan pablo cisterna:
Thanks James for the powerpoint!

James Acker:
Richard also joins us from GSFC.

RICHARD HANSELL:
well thanks again Jim.

slide 1: I want to share some results from a recent study on the longwave (LW) direct radiative effects of mineral dust.

I ask the question, "how significant are these effects"?

Before I begin, I want to thank all of my collaborators.

Slide 2: Here's my outline. The image on the right really provides incentive for studying dust in the first place. The global extent of this storm was phenomenal. Extending from the deserts in China to as far as Maryland.

Besides impacting visiblity (~ 65 feet for this storm) and air quality, dust aerosols can perturb the energy budget of the atmosphere, both directly and indirectly. Here I focus on the direct impacts.

Slide 3: Primary motivation for this work stems from model uncertainties of the radiative effects of dust. The shortwave (SW) effects are generally easier to measure but the longwave (LW) impact, on the other hand, is rather difficult to ascertain since the measured dust signal level (~10 Wm-2) is on the same order as the instrumental uncertainties. Models generally don't include longwave effects,but recent works suggest that these can be important.

Slide 4: Here I focus on two past field experiments to examine the direct radiative effects of dust. The first site was at Sal Island Cape Verde (upper left - circled region) during NAMMA 2006 for studying transported Saharan dust. Located about 350 miles from Senegal, Cape Verde is frequently exposed to blowing dust from the African Continent.

Dust(and many clouds)is evident as shown in Terra MODIS image (lower right) during the experiment on 11 Sept 2006

7-day back trajectories (Jeong et al. 2008) show that various desert source regions on the continent contribute to the loading seen over the islands.

Here are some images from the deployment showing the NASA team and instrumentation from the mobile ground-based laboratories (SMARTLabs). For more details please visit our site (http://smartlabs.gsfc.nasa.gov/).

James Acker:
Are you the one wearing the straw hat?

RICHARD HANSELL:
Yes

The facilities integrate a comprehensive suite of surface remote sensing and in-situ instruments that span the UV to the microwave for observing properties of the atmosphere, including clouds, aerosols, and trace gases.

Included are flux radiometers (SW & LW), radiance sensors (spectral & narrowband measurements), active lidars, FTIR, aerosol microphysics and chemistry, trace gases and an array of other essential sensors and suporting equipment. More recently we've added a third trailor to include cloud radars.

slide 6: the second site was at Zhangye China during the Asian Monsoon Years (AMY) field campaign (2008). Zhangye is a semi-arid region nestled between the Taklamakan and Gobi Deserts and is an ideal location for assessing dust radiative impacts.

MODIS RGB image (bottom left) shows heavy dust from Taklamakan Desert streaming over Zhangye (Circle). Panel (bottom right) shows the D* dust parameter (Hansell et al. 2007) from same MODIS scene where D*>1 = dust and D*<1 = cloud.

Computed 72-hour back-trajectories at 3 km (Ge et. al 2010) show that air masses converge at Zhangye mostly from the North and N. West regions of China.

slide 7: Here are some images of the instrument set-up in Zhangye. SMARTLabs mobile labs are shown with aerosol/trace gas measurements on the left and radiation measurements on the right.

slide 8: An Atmospheric Emitted Radiance Interferometer (AERI) was used to capture the IR spectra (~3-18 microns)of the overlying atmosphere, including dust aerosols. Dust optical depths were retrieved from the spectral radiance measurements (Hansell et al. 2008).

slide 9: NASA's on-line Giovanni system was used in our most recent study (top panel - Hansell et al. 2012) to illustrate the heavy dust loading in the vicinity of Zhangye during the AMY experiment. Shown are the averaged retrieved optical depths from the more dust active period using NASA Goddard's Deep Blue aerosol retrieval algorithm (Hsu et al. 2004 and 2006).

Giovanni allowed us to make rapid assessments of and better understand the regional aerosol distribution and loading of dust.

slide 11: In the thermal IR, the refractive indices (composition) of dust minerals are variable, especially the absorption component. We constrain particle size using our in-situ measurements. Particle shape we assume to be spherical and employ Mie code for simplicity, although it's well known dust particles are typically non-spherical. Shape effects in the IR have been reported in previous works (e.g., Hudson et al. 2008; Hansell et al. 2011).

slide 15: Our dust mineralogy information at Zhangye was based on a previous composition study (Table - upperleft) which identified various key minerals. For Cape Verde, we employed the commonly used Volz data set (Volz et al. 1973) for Saharan dust - bottom plot.

slide 16: Computed effective refractice indices for Zhangye (left) and Cape Verde (right). A comparison of the resulting single-scattering parameters (bottom). In the IR, the dust at Zhangye was found to be more absorptive.

slide 18: Simple depiction of the radiative flow of energy in a dusty atmosphere. Computation of direct radiative effects is given by the equation below which accounts for fluxes in an aerosol and aerosol-free atmosphere.

slide 19: Here is the methodology used in the study beginning with a raw radiance spectrum (FTIR) to calculating surface irradiances for determining the radiative impacts. Cloud screening is also performed as well as intermediate comparison checks with other collocated/ coincident measurements.

slide 21: Retrieved optical depths are then inputted into a 1-D broadband radiative transfer code along with other measured constraints (e.g., atmospheric parameters) for calculating surface fluxes with/without aerosols. Results showed that the direct effect at Zhangye is ~ 2x larger than that found at Cape Verde.

slide 22: The radiative forcing eficiency (Wm^-2 per unit AOT) at Zhangye is about a factor of two larger than that found at Cape Verde. This compares well with an earlier satellite study (Xia et al. 2009) over the Taklamakan Desert.

The longwave radiative effect was two times larger at Zhangye than that compared to Cape Verde.

slide 23: The diurnally averaged shortwave radiative effect was also examined and was found to be ~-60 Wm^-2 per unit AOT. The longwave impact was determined to be ~51-58% of the shortwave effect. Bottom line: over one-half of the shortwave cooling was found to be compensated by longwave warming. The level of longwave significance is linked to how well the single-scattering albedo is constrained.

slide 24: Similarly, the TOA longwave impact was found to be ~60% larger at Zhangye than at Cape Verde, meaning less IR energy is escaping to space due to the absorbing dust layers.

slide 25: Heating rates at Zhangye, on average, were found to be ~0.3 K/day with maximum values reaching up to 1.5 K/day. Strong peaks demonstrate the potential for dust to impact surface temperatures, moisture budgets, and the atmospheric stability.

slides 26-27: Here is a summary of key points in the study. Overall, the dust longwave impact at a regional scale has the potential to leverage the shortwave cooling effects. The upper range in the longwave impact is comparable to cloud radiative effects and thus can be climatically significant.

James Acker:
Thank you Richard. How long have you had the instruments in the Cape Verde Islands?

Thanks. We have seen lots of MODIS dust images over that region.

Dust is certainly pervasive; I flew through the Denver airport last week, and could not see the mountains due to the suspended dust. I've seen them in travel during the winter.

Natalia Chubarova:
Just remark: during the severe fires near Moscow 2010 we have around +50 Wm-2 in the longwave irradiance effect only due to aerosol but AOT at 500nm was arount 5-6

James Acker:
I'll note to all participants that with the permissin of the presenters, we'll provide email addresses for contact when their presentations are placed online.

Thanks Natalia.

That wraps up the morning session. See you back here at 2:00 for our oceans theme session, also with Dr. Zhen Liu on atmospheric chemistry over China.

That's 2:00 PM EDT, folks!

RICHARD HANSELL:
Thanks again James. Should I close out my PPT?

juan pablo cisterna:
Can i Download PPT?

James Acker:
Juan, the PPT will be placed online after the workshop. We'll give the presenters some days to tune them up.

Plus the associated chat will be available with the presentation.

And hopefully pictures of the presenters!

juan pablo cisterna:
Thanks again James!

James Acker:
Follow us on Twitter (@nasa_giovanni) or check the GES DISC home page for News to see when we have the presentations available.